

AMENDMENT UNDER 37 C.F.R. § 1.111
U.S. Patent Application No. 09/762,233

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

LISTING OF CLAIMS:

1. (Currently Amended) A method of driving a display having a panel including substrates having an array of scanning electrodes on one of substrate, an array of signal electrodes on other substrate, and liquid crystal cells between the said electrodes at their intersection points, the said cells generating display elements of the display, comprising the steps of:

selecting scanning electrodes in one-by-one or group-by-group sequence, applying scanning voltages to the selected scanning electrodes, and applying a reference voltage (V_r) level V_o to the non-selected scanning electrodes;

applying to a signal electrode, during a selection period, a basic voltage level or levels consisting of a level or levels unequal to V_r level or/and of V_o level to a signal electrode unequal to or approximately equal to the reference voltage level V_o for obtaining current values of brightness of a selected display element or of a group of selected display elements; the distinguishing step of: and

applying to the signal electrode, during the selection period, two additional voltage levels having different polarities with respect to the reference voltage level V_o , the same constant modules of deviation from V_r level the reference voltage level V_o , and constant and equal duration to the signal electrode.

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2. (Currently Amended) A method of driving a display having a panel including substrates having an array of scanning electrodes on one of substrate, an array of signal electrodes on other substrate, and liquid crystal cells between the said electrodes at their intersection points, the said cells generating display elements of the display, comprising the steps of:

selecting scanning electrodes in one-by-one or group-by-group sequence, applying scanning voltages to the selected scanning electrodes, and applying a reference voltage (V_0 -level) level V_0 to the non-selected scanning electrodes;

applying to a signal electrode, during a selection period $\{T\} T_r$, a basic voltage level or levels consisting of a level or levels unequal to V_0 level or/and of V_0 level to a signal electrode unequal to or approximately equal to the reference voltage level V_0 for obtaining current values of brightness of a selected display element or of a group of selected display elements; the distinguishing steps of:

applying to the signal electrode, during the selection period T_r , two additional first and second voltage levels having different polarities with respect to the reference voltage level V_0 , the same constant-modules $\{V_m\} V_m$ of deviation from V_0 level the reference voltage level V_0 , and constant and equal duration $t_m/2$ $\{t_m/2\}$ to the signal electrode; and

applying to the signal electrode, during the selection period T_r , after applying a the first voltage of one a first polarity about V_0 level and before applying a the second voltage of either a

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second polarity about V_0 -level, the a third additional V_0 -voltage voltage level approximately equal to the reference voltage level V_0 having a constant duration t_0 to the signal electrode.

3. (Currently Amended) The method of claim 2, wherein durations of the basic voltage levels applying applied to the signal electrode are varied for obtaining a particular current value of brightness of the selected display elements and are adjusted in such a way

that under one-line selection, during a period T_r , the sum duration of all basic voltage levels is equal to constant value ($T_r - t_m - t_0$) or,

that under multiple-line selection, during all periods of selection the same display elements in frame time, the averaged over the period T_r , sum of products of duration of every basic voltage level unequal to the reference voltage V_0 to square of inverted ratio of modulus of deviation of the said level from V_0 -level the reference voltage level V_0 to modulus of deviation (from V_0 -level) the reference voltage level V_0 of the basic level for the said display one-line selected by the said method (with with the same values $t_m/2$ and V_m of the said pair of additional the first and second levels and with the same duration to of the said third additional V_0 -level) level is equal to constant value ($T_r - t_m - t_0$).

4. (Currently Amended) A method of driving a display having a panel including substrates having an array of scanning electrodes on one of substrate, an array of signal electrodes on other substrate, and liquid crystal cells between the said electrodes at their

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intersection points, the said cells generating display elements of the display, comprising the steps of:

selecting scanning electrodes in one-by-one or group-by-group sequence, applying scanning voltages to the selected scanning electrodes, and applying a reference voltage (V_0 -level) level V_0 to the non-selected scanning electrodes;

applying to a signal electrode, during a selection period (T_r) T_r , a basic voltage level or levels consisting of a level or levels unequal to V_0 -level or/and of V_0 -level to a signal electrode unequal to or approximately equal to the reference voltage level V_0 for obtaining current values of brightness of a selected display element or of a group of selected display elements; the distinguishing steps of:

applying, during the period T_r , two-additional first and second voltage levels having different polarities, the same constant modules of deviation from V_0 -level the reference voltage level V_0 , and constant and equal duration to the signal electrode, the said additional the first and second voltage levels being allocated to the boundary portions of the period T_r , so that one the first level is allocated to the a beginning portion and the other second level is allocated to the an end portion of the period T_r ;

applying, during the period T_r , voltage levels to the signal electrode in direct or in reverse order; and

alternating, in succeeding periods T_r , the said orders of applying of voltage levels to the signal electrode on the basis of changing of the polarity of the voltage deviation from V_0 -level the reference voltage level V_0 in the beginning (and, accordingly, in the end)-of the period T_r , so

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that the positive polarity ~~being~~ is set in the beginning of one period T_s , and the negative polarity ~~being~~ is set in the beginning of the next period T_r .

5. (Currently Amended) A method of driving a display having a panel including substrates having an array of scanning electrodes on one of substrate, an array of signal electrodes on other substrate, and liquid crystal cells between the ~~said~~ electrodes at their intersection points, the ~~said~~ cells generating display elements of the display, comprising the steps of:

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selecting scanning electrodes in one-by-one or group-by-group sequence, applying scanning voltages to the selected scanning electrodes, and applying a reference voltage (V_e -level) level V_g to the non-selected scanning electrodes;

applying to a signal electrode, during a selection period (T_s) T_r , a basic voltage level or levels consisting of a level or levels unequal to V_e -level or/and of V_g -level to a signal electrode unequal to or approximately equal to the reference voltage level V_g for obtaining current values of brightness of a selected display element or of a group of selected display elements; the distinguishing steps of:

applying, during the period T_r , two additional first and second voltage levels having different polarities, the same constant modules of deviation from V_e -level the reference voltage level V_g , and constant and equal duration to the signal electrode, the said additional the first and second voltage levels being allocated to the boundary portions of the period T_r , so that one the

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first level is allocated to ~~the a~~ beginning portion and the other second level is allocated to ~~the an~~ end portion of the period T_r ;

applying, during the period T_r , voltage levels to the signal electrode in direct or in reverse order; and

applying, during the period T_r , voltage levels to adjacent signal electrodes or to signal electrodes located one or two electrodes further or to signal electrodes having another type of activation sequence so that the levels allocated to the beginning portion (~~and, accordingly, and to~~ the end portion) portion of the period T_r have deviations of opposite polarities from V_o level the reference voltage level V_o .

6. (Currently Amended) A method of driving a display having a panel including substrates having an array of scanning electrodes on one of substrate, an array of signal electrodes on other substrate, and liquid crystal cells between the said electrodes at their intersection points, the said cells generating display elements of the display, comprising the steps of:

selecting scanning electrodes in one-by-one or group-by-group sequence, applying scanning voltages (V_s) V_s to the selected scanning electrodes, and applying a reference voltage (V_o level) level V_o to the non-selected scanning electrodes;

applying to a signal electrode, during a selection period (T_s) T_s , a basic voltage level or levels consisting of a level or levels unequal to V_o level or and of V_o level to a signal electrode unequal to or approximately equal to the reference voltage level V_o for obtaining current values

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of brightness of a selected display element or of a group of selected display elements; the distinguishing steps of:

applying, during the period T_r , two additional first and second voltage levels having different polarities, the same constant modules of deviation from V_o -level the reference voltage level V_o , and constant and equal duration to the signal electrode, the said additional first and second voltage levels being allocated to the boundary portions of the period T_r so that one the first level is allocated to the a beginning portion and the other second level is allocated to the an end portion of the period T_r ;

applying, during the period T_r , voltage levels to the signal electrode in direct or in reverse order; and

alternating, during periods T_f , of selecting the same scanning electrode or the same group of scanning electrodes where the scanning voltages or the scanning voltage groups have identical or opposite polarities about V_o -level the reference voltage level V_o , the said order of the applying the signal voltage levels to the signal electrode (during during the period T_r) T_f in succeeding frame time periods or in a frame time or in two frame time or in accord with other order of comparison in time by setting alternately the same and opposite directions of the deviation (from V_o -level) from the reference voltage level V_o of the signal voltage level allocated to the beginning (and, accordingly, and to the end) portion of the period T_r and of the deviation (from V_o -level) from the reference voltage level V_o of the voltage V_r applied to the said same selected scanning electrode or to the same selected scanning electrode of the said same selected group.

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7. (Currently Amended) A method of driving a display having a panel including substrates having an array of scanning electrodes on one of substrate, an array of signal electrodes on other substrate, and liquid crystal cells between the said electrodes at their intersection points, the said cells generating display elements of the display, comprising the steps of:

selecting scanning electrodes in one-by-one or group-by-group sequence, applying scanning voltages to the selected scanning electrodes, and applying a reference voltage (V_0 -level) level V_0 to the non-selected scanning electrodes;

~~applying to a signal electrode, during a selection period (T_s) T_s , a basic voltage level or levels consisting of a level or levels unequal to V_0 level or/and of V_0 level to a signal electrode unequal to or approximately equal to the reference voltage level V_0 for obtaining current values of brightness of a selected display element or of a group of selected display elements; the distinguishing steps of:~~

~~applying, during the period T_s , two additional first and second voltage levels having different polarities, the same constant modules of deviation from V_0 level the reference voltage level V_0 , and constant and equal duration ($t_m/2$) $t_m/2$ to the signal electrode, the said additional first and second voltage levels being allocated to the boundary portions of the period T_s , so that one the first level is allocated to the a beginning portion and the other second level is allocated to the an end portion of the period T_s ;~~

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applying, during the period T_r , voltage levels to the signal electrode in direct or in reverse order so that the order of their applying to the signal electrode is alternated in succeeding periods T_r ; and

splitting the voltage pulses applied to signal electrodes into a number of groups being related to different electrodes and shifting the pulses in time concerning their nominal positions in the period T , so that the values of shifting time are the same for the pulses of a single group, but are different for the pulses of different groups, and constant for certain period, after termination the said time period, other values of shifting time are set in certain or in all groups of voltage pulses or other aggregate of groups of voltage pulses is formed with different values of shifting time in various groups, and the other values of shifting time are set constant for the next time period, after termination of which the said process of either changing or setting constant values of shifting time are continued providing zero average deviation of duration of each said additional level from its nominal duration.

8. (Original) The method of claim 7, wherein modulus of shifting times of voltage pulses applied to a group of the signal electrodes are set in the range of values from zero to $t_m/2$.

9. (Original) The method of claim 7, wherein, after termination of the time period during which the shifting time values of groups of voltage pulses applied to the signal electrodes are kept constant, the latest shifting time value are set in the group of pulses, each having the earliest shifting time value, the previous shifting time value is set in the group of pulses, each

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having the next after the earliest shifting time value, and such changing of shifting time values is applied in other groups up to group of pulses, each having the earliest shifting time value, which are changed to the latest shifting time value.

10. (Original) The method of claim 7, wherein a group of voltage pulses having the same shifting time is formed for a group of signal electrodes in such a way that each electrode is distant from other electrodes in the group.

11. (Currently Amended) A method of driving a display having a panel including substrates having an array of scanning electrodes on one of substrate, an array of signal electrodes on other substrate, and liquid crystal cells between the ~~said~~ electrodes at their intersection points, the ~~said~~ cells generating display elements of the display, comprising the steps of:

selecting scanning electrodes in one-by-one or group-by-group sequence, applying scanning voltages to the selected scanning electrodes, and applying a reference voltage (V_r -level) level V_o to the non-selected scanning electrodes;

applying, during a selection period, pulses of voltage to a signal electrode, the ~~said~~ pulses setting a basic voltage level or levels consisting of a level or levels unequal to V_r -level or/and of V_o -level unequal to or approximately equal to the reference voltage level V_o , the ~~said~~ levels setting nominal values of mean square voltage on the selected cell or cells for obtaining current

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values of brightness of a selected display element or of a group of selected display elements; the distinguishing steps of:

applying, during the selection period, ~~two additional~~ first and second voltage levels having different polarities, the same constant modules of deviation from V_e , level the reference voltage level V_e , and constant and equal duration to the signal electrode, the said additional first and second levels setting practically approximately constant (in time) deviations from the nominal values of mean square voltage on cells connected with the signal electrode, the said deviations being caused by distortions of a shape of the voltage pulses in process of their propagation along the signal electrode;

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providing, during a frame time period, a single or several additional time intervals (t_c) t_c ;
applying, during some mentioned single or several intervals t_c , compensative voltages

$V_{com}(i)$ to each i-th scanning electrode, beginning with a certain electrode,

or/and and during other mentioned single or several intervals t_c , applying compensative voltages $V_{com}(j)$ to each j-th signal electrode, beginning with other certain electrode, the said voltages $V_{com}(i)$ or/and, respectively, $V_{com}(j)$ having values or/and durations specific to each electrode and giving the total or a partial compensation of the deviations of the mean square voltages on the sells cells of the i-th scanning electrode from their nominal values or/and, respectively, of the deviations of the mean square voltages on the sells cells of the j-th signal electrode from their nominal values, the said deviations initiated by the said distortions of shape of the signal voltage pulses in process of their propagation along the signal electrode, or/and and,

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respectively, initiated by distortions of shape of the scanning voltage pulses in process of their propagation along the scanning electrode; and

applying, during the mentioned intervals t_c , the reference voltage or a quasi-reference voltage or a quasi-reference voltage on average or their combination to the scanning ~~or/and and~~ and to the signal electrodes free from the said compensative voltages.

12. (Currently Amended) A method of driving a display having a panel including substrates having an array of scanning electrodes on one of substrate, an array of signal electrodes on other substrate, and liquid crystal cells between the said electrodes at their intersection points, the said cells generating display elements of the display, comprising the steps of:

selecting scanning electrodes in one-by-one or group-by-group sequence, applying scanning voltages to the selected scanning electrodes, and applying a reference voltage (V_0 -level) level V_0 to the non-selected scanning electrodes;

applying, during a selection period, pulses of voltage to a signal electrode, the pulses setting a basic voltage level or levels consisting of a level or levels unequal to V_0 level or/and of V_0 level unequal to or approximately equal to the reference voltage level V_0 to a signal electrode, the ~~said~~ levels setting nominal values of mean square voltage on the selected cell or cells for obtaining current values of brightness of a selected display element or of a group of selected display elements; ~~the distinguishing steps of:~~

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applying, during the selection period, two-additional first and second voltage levels having different polarities, the same constant modules of deviation from V_0 level the reference voltage level V_0 , and constant and equal duration to the signal electrode, the said additional first and second levels setting practically constant (in time) deviations from the nominal values of mean square voltage on cells connected with the signal electrode, the said deviations being caused by distortions of a shape of the voltage pulses in process of their propagation along the signal electrode;

applying, during the selection periods, additional compensative voltages to selected scanning electrodes, beginning with a certain electrode, and superimposing the said compensative voltage on the scanning voltage, the said compensative voltage having value or/and duration specific to the selected scanning electrode and total or a partial compensating the deviations of the mean square voltages on the cells of the selected scanning electrode from their nominal values, the said deviations being caused by the said distortions of shape of the signal voltage pulses in process of their propagation along the signal electrode.

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13. (Currently Amended) A method of driving a display having a panel including substrates having an array of scanning electrodes on one of substrate, an array of signal electrodes on other substrate, and liquid crystal cells between the said electrodes at their intersection points, the said cells generating display elements of the display, comprising the steps of:

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selecting scanning electrodes in one-by-one or group-by-group sequence, applying pulses of scanning voltages to the selected scanning electrodes, and applying a reference voltage (V_0 -
~~level~~) V_0 to the non-selected scanning electrodes;

applying pulses of voltage to a signal electrode, the said pulses setting basic voltage level or levels setting nominal values of mean square voltage on selected ~~cells~~ cells for obtaining nominal values of brightness of selected display elements; ~~the distinguishing step of:~~

forming voltage pulses in the shape providing total or partial self-compensation of spurious changes of the mean square voltages on the selected ~~cells~~ cells, the said changes initiated by distortions of fronts and tails of the pulses in process of their propagation along display electrode electrodes.

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14. (Currently Amended) The method of claim 13, wherein the front of pulse is formed in stepwise shape or in the shape similar to stepwise one.

15. (Currently Amended) A method of driving a display having a panel including substrates having an array of scanning electrodes on one of substrate, an array of signal electrodes on other substrate, and liquid crystal cells between the ~~said~~ electrodes at their intersection points, the ~~said~~ cells generating display elements of the display, comprising the steps of:

selecting scanning electrodes at least two times ~~or more times~~ a frame in sequence two by two, applying scanning voltages (V_{x1} and V_{x2}) V_{x1} and V_{x2} to selected scanning electrodes, and

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applying a reference voltage (V_0 -level) level V_0 to the non-selected scanning electrodes, wherein polarities of deviation of the scanning voltages V_{r1} and V_{r2} from V_0 -level V_0 -level the reference voltage level V_0 are set either same or opposite order (or in reverse order, or in mixed order);

applying, during a selecting period (T_s) T_r , a basic voltage level or levels having the same modulus V_c of deviation from the reference voltage level V_0 or and of V_0 -level equal to the reference voltage level V_0 to a signal electrode for obtaining current values of brightness of selected display elements; and the distinguishing step of:

A.1 forming the said unequal to V_0 -level basic voltage levels having the same modulus V_c of deviation from the reference voltage level V_0 to be being composed of an information component and of quasi-reference equalizing components such

that the duration and the polarity of deviation from V_0 -level the reference voltage level V_0 of the information component, during the period T_r of the applying the scanning voltages V_{r1} and V_{r2} with the same polarities of deviation from V_0 -level the reference voltage level V_0 , being set in ratio to the value of half sum of brightness of the selected display elements (or with correction of the ratio taking into account an non-linearity of an electro-optic behavior of the display element) element,

that the duration and the polarity of deviation from V_0 -level the reference voltage level V_0 of the information component, during the period T_r of the applying the scanning voltages V_{r1} and V_{r2} with opposite polarities of deviation from V_0 -level, being set in ratio to the value of half difference between brightness of the selected display elements (or with the said correction of the ratio taking into account the said non-linearity) non-linearity, and

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that the common duration of the quasi-reference equalizing components being set, during any or both periods T_r in the frame of selecting the same display elements, to bring the common duration of all levels unequal to V_o (~~for for the said same selected display elements~~) elements to a constant value.

16. (Currently Amended) The method of claim 15 ~~including claim 1~~, wherein the ~~said~~ constant value of common duration of all signal voltages levels unequal to V_o and applied to the signal electrode for the same elements selected in both periods T_r of the frame, the levels including information component, equalizing component, and two additional levels with different polarities, constant modules of deviation from V_o -level equal to V_c , and constant and equal duration $(t_m/2)$, the ~~said~~ additional levels set during every period T_r , is equal to (T_r+t_m) T_r+t_m .

17. (Currently Amended) A device for driving a display having a panel including substrates having an array of scanning electrodes on one of substrate, an array of signal electrodes on other substrate, and liquid crystal cells between the ~~said~~ electrodes at their intersection points, the ~~said~~ cells generating display elements of the display, the display driven by the method ~~variants of claims from 1 to 16 realized separately or in their combinations of~~ claim 1, comprising:

a voltage level generator (~~or power supply block~~) and a bunch plurality of voltage pulsers pulses for the display electrodes, each voltage pulsers pulse containing a block setting timing

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voltage levels to an output electrode, the output electrode, and an output transistor block connected with the output electrode, with the voltage level generator and with the block setting timing voltage levels connected with the voltage level generator, characterized in that wherein

the block setting timing voltage level to the output signal electrode contains technical means to for timing additional voltage levels of constant duration, applying to the signal electrode; and

the output transistor block is fixed in such a way that the output resistances for different voltage levels of the said block has the same values, or the deviation of values does not exceed 10%.

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18. (Currently Amended) A method of driving a display having a panel including substrates having an array of scanning electrodes on one of substrate, an array of signal electrodes on other substrate, and liquid crystal cells between the said electrodes at their intersection points, the said cells generating display elements of the display, having value of display parameter N_{max} greater or equal to number N_{max0} where N_{max0} is the minimum value of N_{max} of the display capable to correct driving by voltage waveforms in accordance with the method ~~variants of claims from 1 to 16, realized separately or in their combination of claim 1,~~ comprising the steps of:

selecting scanning electrodes in sequence one by one or group by group, applying scanning voltages $\{V_s\} V_s$ to the selected scanning electrodes, and applying a reference voltage $\{V_o\}-level\} V_o$ to the non-selected scanning electrodes;

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applying, during a selecting period, a basic voltage level or levels (V_e , V_c) consisting of a level or levels unequal to V_e level or/and of V_c level the reference voltage level V_o or the reference voltage level V_a to a signal electrode for obtaining current values of brightness of a selected display element or of a group of selected display elements; and the distinguishing steps of:

applying the voltages V_r about $|V_{ro}| \sqrt{1-\eta}$ to the scanning electrodes,

applying the voltages V_c about $|V_{co}| \sqrt{1+\eta}$ to the signal electrodes,

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wherein $|V_{ro}|$ and $|V_{co}|$ are the modules of the voltages V_r and V_c applied to another (reference) display having the value of N_{max} equal to N_{maxo} , the said other display driven correctly by the method of the mentioned claims, and η is a number parameter for tailoring of the voltages V_r and V_c to the correct driving or close to the correct driving of the said display having N_{max} greater or equal to N_{maxo} .

19. (Currently Amended) A display having a panel including substrates having an array of scanning electrodes on one of substrate, an array of signal electrodes on other substrate, and liquid crystal cells between the said electrodes at their intersection points, the said cells generating display elements of the display, characterized in that wherein

the display elements are made having the value of display parameter N_{max} greater or equal number N_{maxo} , where N_{maxo} is greater number N and N_{maxo} is the minimum value of N_{max} of

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~~a display capable to correct driving by voltage waveforms in accordance with the method~~

~~variants of claims from 1 to 16, realized separately or in their combination of claim 1.~~